

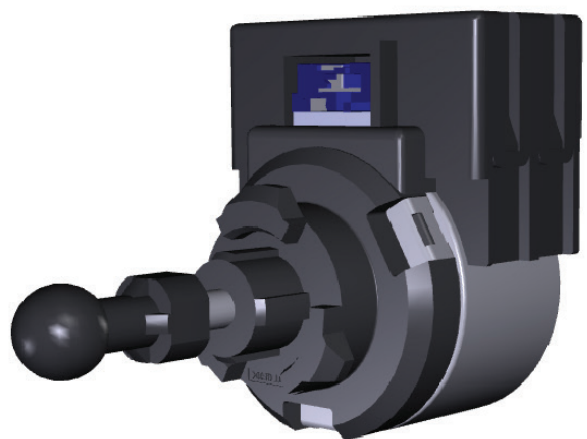
# Linear Stepper Motors: The Driving Force for Adaptive Headlight Systems



Renting a car overseas, drivers from the US might not notice an Adaptive Headlight System at first. While driving on uneven terrain or up and down hills, and during accelerating and braking, this system detects where illumination is needed, and compensates by moving the headlamps into the best position. When this system senses vertical changes in the front end of the car, it automatically adjusts the headlamp angle to provide the driver the best illumination possible. When changing speeds, the system can either extend the range of illumination to increase reaction time during acceleration, or shorten to coincide with braking and slower speeds.

In addition, some systems can also adjust the lights horizontally, and will automatically move the headlamps left or right when sensing the vehicle turning to help the driver maintain awareness of the road ahead. These systems of automatic headlamp “leveling” and “bending” improve driver reaction times, and stop headlights from blinding oncoming drivers, enhancing the vehicle’s safety features. While still not standard in most US vehicles, these systems are being adopted by many other countries, and offer a dramatic advantage for nighttime driving.

For these Adaptive Headlight Systems, a linear stepper motor controls the vertical movement (leveling) of the headlamps, and an additional linear stepper motor controls the horizontal movement (bending). System sensors and control units direct the action in real-time, but the heart of each system is the linear stepper motor itself. “Linear” refers to the threaded output shaft that pushes and pulls the headlamp up and down, in precise, measured movements.

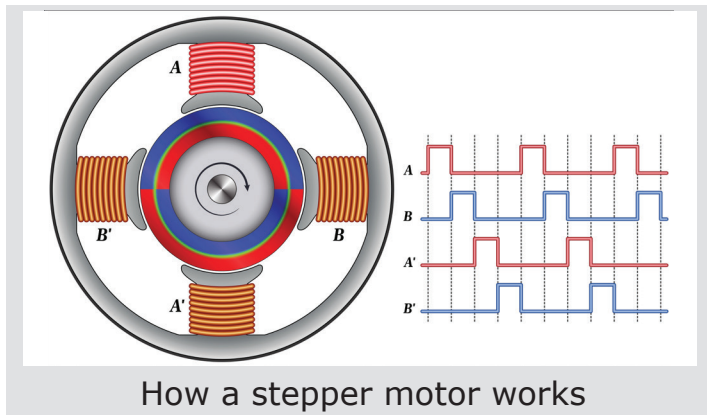


PL35L Linear Stepper Motor with LIN2.x



## Linear Stepper Motors for Active Headlights

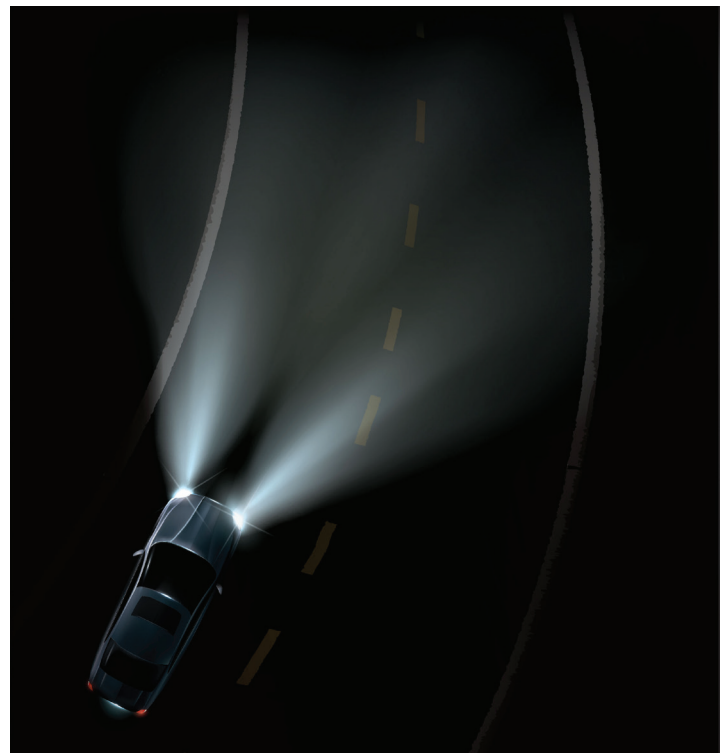
Step motors convert electrical energy into precise mechanical motion. These motors rotate a specific incremental distance per each step. The number of steps executed controls the degree of rotation of the motor's shaft. This characteristic makes step motors excellent for positioning applications. For example, a  $1.8^\circ$  step motor executing 100 steps will rotate exactly  $180^\circ$  with some small amount of non-cumulative error. The speed of step execution controls the rate of motor rotation. A  $1.8^\circ$  step motor executing steps at a speed of 200 steps per second will rotate at exactly 1 revolution per second.



How a stepper motor works

The core of a linear stepper's rotor contains a nut, and as this rotates, it pulls or pushes the threaded shaft in or out of the motor. This linear actuation moves the headlight into the proper position. This robust motor is designed to produce incremental movement in a compact envelope. It creates precise and accurate adjustments of the headlamps to always keep the vehicle's lights correctly positioned on the road ahead. Without it, headlights are able to shine into oncoming traffic, distracting other drivers, or not light up the road ahead adequately, increasing the potential for serious safety hazards.

MinebeaMitsumi offers a wide range of features on our linear stepping motors, allowing us to provide a customized solution for any Adaptive Headlight System. The PL line represents our standard linear stepper motor, used in the majority of these systems globally. Our local engineering resources allow NMB to provide rapid development for fully customized linear stepper motors. This can include drivers, controllers, as well as LIN bus communication capability through a custom designed ASIC, creating a smart actuator that is tailored to each individual platform.



Active safety features such as Adaptive Headlight Systems contribute towards a safer and more precise driving experience. MinebeaMitsumi linear stepper motors offer a robust solution for applications requiring precise positioning, high performance and advanced customization.